Received 9 December 2016
Revised 30 March 2017
Accepted 9 June 2017

Assessing competitive position of Uruguay's beef sector

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Abstract

Purpose – The purpose of this paper is to present an economic evaluation of Uruguay's beef industry competitiveness to quantify the effects of public policies (taxes, subsidies, social charges) on the various links constituting the beef export chain and estimate the impact of transfers of resources between the beef industry and other sectors of the economy.

Design/methodology/approach – The Policy Analysis Matrix (PAM) techniques were employed to quantify the effects of public policies on the competitiveness of Uruguay's beef industry. A series of PAM coefficients were calculated to assess the competitiveness of the beef export chain in 2010 and 2013 with comparison between the two years to make policy recommendations.

Findings – Beef sector returns captured by private agents decreased from 30 percent in 2010 to 10 percent in 2013. Competitiveness of the beef export chain deteriorated between 2010 and 2013 due primarily to higher prices paid for live cattle by the beef slaughtering, manufacturing, and packing sector. Uruguay's beef industry transfers resources to the larger economy via social security payments and is penalized as a result of high capital costs.

Research limitations/implications – Although three different sources of resource transfers were identified, more effort is needed to improve the precision of estimations.

Originality/value – The competitiveness of export chains is critical to the economic and social wellbeing of small-economy countries. They must be efficient producing for the international markets at the time they constitute pillars of the whole economy.

Keywords Competitiveness, Export markets, Livestock, Developing countries, Food industry, Economic sustainability, Common agricultural policy

Paper type Research paper

1. Introduction

Global beef trade is big business. Total world beef exports are expected to reach 10 million metric tons in 2016 – a 23 percent increase since 2011 (USDA, 2015a). Beef demand growth has been driven by increasing numbers of consumers with sufficient purchasing power and desire to consume greater quantities of animal protein. Bovine meat is produced and consumed worldwide, under both land-extensive grass-fed and confinement grain-fed conditions, or with a combination of grass and grain feeding throughout the beef animals' life cycle. Global beef markets are dominated by India, Brazil, Australia, and the USA, which accounted for almost two-thirds of 2014 exports. The top exporters are followed by New Zealand, Paraguay, Uruguay, Canada, the European Union (EU), and Mexico. This mix of exporting countries represents the spectrum of beef production systems from animals raised to slaughter with no grain supplementation to animals produced under intensive feedlot conditions. The value of beef and beef product exports from all countries was USD54 billion in 2014 (USDA, 2015b).

The beef product which moves through world trade is conventionally considered a commodity, but one that has undergone significant processing during the transformation from live animal to shipping container meat. The complex value-adding beef supply chain

Journal of Agribusiness in Developing and Emerging Economies
Vol. 8 No. 2, 2018
pp. 288-302

2044-0839
DOI 10.1108/JADEE-12-2016-0078

has multiple stages and numerous actors; it is thus an important source of economic activity and employment in all the exporting countries noted above. The beef industry is a classic example of nations (and regions) exploiting natural resource endowments that have limited opportunities for utilization by other sectors. Low value pasture forage in countries such as Uruguay and Paraguay is transformed by the bovine animal's digestive system into a storable, shippable, and high-value product in great demand throughout the world.

While Paraguay is a relative newcomer to global beef export markets, Uruguay has a long history of supplying grass-fed beef to the world. Early Spanish explorers defined the vast expanse of land which is modern-day Uruguay as "sin ningún provecho," or was basically good for nothing (Reyes *et al.*, 1974). The explorers were looking for mineral wealth and finding none on the plains east of the Uruguay River determined that the area was a wasteland. However, it was a natural resource base well suited to grazing cattle and sheep. The country's meat production capacity was of particular importance during the Second World War, when it supplied the Allies with much needed animal protein (particularly useful in the form of canned, ready-to-eat corned beef). In the post-Second World War era, Uruguay's livestock and beef sectors were ignored (at best) or subject to national policies which impaired export market participation. Earlier British investments in Uruguay's meat packing facilities were nationalized, labor disputes frequently disrupted the industry, and Uruguay's position as a significant player in global meat markets deteriorated. As the twenty-first century approached, Uruguay pursued liberalization of its economy and encouraged export-driven agricultural development. Beef exports exploded in the late 1990s, as the livestock and meat sectors resumed prominent positions in the nation's economic growth and development (INAC, 2007, 2015).

Uruguay has accounted for near 5 percent of global beef exports in recent years (FAOSTAT, 2013). That share is larger than those of Canada, the EU, Mexico, or Argentina, and is generated by a nation where the total cattle herd close to 12 million animals outnumbers the human population by 4:1. Uruguayan beef is exported to five continents. The meat (both grained and grass-fed) is well accepted by consumers worldwide because of its high quality. The nation's beef industry (as well as the entire nation, and, in particular, the tourism sector) is currently positioning itself as "Uruguay Natural" within the world market, having moved "from nature to table," without the use of antibiotics or artificial growth stimulants, banned by law since more than two decades (MGAP, 2001). Analysts argue that the country has great potential to differentiate its products; however, building a distinctive Uruguayan beef brand will involve time and effort and investment. The use the "Pastos-Uruguay" logo next to private brand labels on all export packaging and vacuum-packed cuts is mandatory since 2009 (Bonsignore, 2011).

In 2004, the USDA officially recognized the program of certified natural meat or Programa de Carne Natural Certificada del Uruguay (PCNCU). The PCNCU accomplished the requirements of its Process Verified Program (PVP). Currently there are four PCNCU certification levels: Basic, USDA PVP, Global GAP, and USDA PVP Never Ever 3. The USDA PVT recognizes two categories. The N5 category (source verified, no added hormones, no fed antibiotics, no animal proteins in feed, open range-animals never confined). The N6 adds the "grass fed" requirement, only allowing limited supplementation that not include grains or derivatives. The homologation of PCNCU with Global GAP was obtained in 2008 and includes the certification of good agricultural practices. The "Never Ever 3" protocol is based on good practices in animal production, in addition to assuring food quality and security (INAC, 2016).

Uruguay has one of the world's highest levels of per capita beef consumption; however, regardless of how hard they try, the nation's small population only makes a small dent in total domestic meat supply. Every year, Uruguay exports approximately two-thirds of the country's beef production, which, in turn, represents about 80 percent of its total meat exports.

Uruguay has a unique beef sanitary status. The World Organization for Animal Health (OIE, according to the Spanish acronym) officially recognizes the country with the status of negligible Bovine Spongiform Encephalopathy risk and Foot and Mouth Disease (FMD) free with vaccination (MGAP, 2014; OIE, 2014). The only other country with the same FMD status is South Korea. In 2006, Uruguay started individual animal identification in its livestock sector[1], which became mandatory in 2011. Uruguay now claims 100 percent traceability of the nation's beef herd.

In the last few years, Uruguayan beef exporters have focused on complying with the requirements of the most demanding global markets. The industry is seeking to move beef products into as many countries as possible in order to deal with potential changes in the conditions of access in different markets. The important high-value beef markets in Europe, Asia, and North America are increasingly important to the Uruguayan beef industry, although the industry is diversifying exports beyond those regions.

According to official data published by Uruguay's customs office for 2013, Uruguay exported 235,600 metric tons (MT) of beef products to 54 different countries. The FOB value reached USD1.3 billion. The weighted average price per ton of shipped product was USD5,900. Frozen beef cuts were 85 percent of the exported volume with chilled products accounting for 15 percent of volume. In terms of monetary value, the proportions were 75 percent frozen and 25 percent chilled (URUNET, 2015).

About 39 percent of Uruguayan beef was shipped to Asia; almost all of the beef exported to there is in the form of frozen cuts (Table I). China accounted for 28.6 percent of total beef exports, with 67,300 MT. Israel is a traditional purchaser of kosher-processed forequarter cuts; in 2013, the 22,100 MT shipped to this country were 9.4 percent of export volume. With respect to volume, shipments to Europe represented 30.7 percent of the total while Russia

Destinations	FOB value (thousands USD)	% over total	Shipped weight (MT)	% over total	FOB price (USD/MT)
Europe	505,565	39.1	72,316	30.7	6,991
Russia	114,753	8.9	38,159	12.8	3,805
The Netherlands	105,288	8.1	10,953	4.6	9,613
Germany	83,340	6.4	7,542	3.2	11,049
Italy	48,511	3.8	6,694	2.8	7,247
Spain	41,491	3.2	5,355	2.3	7,748
UK	37,113	2.9	4,585	1.9	8,095
Switzerland	23,392	2.3	2,513	1.1	11,698
Rest of Europe	45,678	3.5	4,515	1.9	10,116
America	369,907	28.6	67,457	28.6	5,484
USA	128,637	9.9	23,433	9.9	5,490
Brazil	74,707	5.8	11,250	4.8	6,640
Chile	66,619	5.2	11,686	5.0	5,701
Venezuela	42,715	3.3	7,251	3.1	5,891
Canada	41,289	3.2	10,478	4.4	3,941
Rest of America	15,938	1.2	3,359	1.4	4,745
Asia	404,111	31.2	91,748	38.9	4,405
China	262,354	20.3	67,347	28.6	3,896
Israel	132,036	10.2	22,121	9.4	5,969
Rest of Asia	9,721	0.8	2,283	1.0	4,259
Africa	7,782	0.6	3,192	1.4	2,438
Oceania	5,877	0.5	899	0.4	6,538
TOTAL	1,293,241	100.0	235,612	100.0	5,489

Note: MT refers to metric tons. Europe includes Russia, Turkey, and European former USSR nations
Source: Based on official data from Uruguay customs (URUNET, 2015)

Table I.
Uruguay:value and volume of beef exports by destination (2013)

accounted for 12.8 percent of shipped weight (38,200 MT). Exports to Western Hemisphere countries were 28.6 percent of volume, with the USA accounting for the largest share (9.9 percent of total volume; 23,400 MT).

Data for Uruguayan beef export values are somewhat different. The leading market is Europe; the FOB value of the beef products shipped there was USD506 million, or 39.1 percent of total beef exports in 2013. The top five importers are the EU nations of the Netherlands, Germany, Italy, Spain, and the UK. Although the volume of beef shipped to those countries (35,100 MT) was only 14.9 percent of total exports, those shipments were 24.4 percent (USD316 million FOB) of total.

Uruguay can sell the EU up to 6,000 MT per year of chilled high-value grass-fed beef cuts (primarily rump and loins) under preferential tariff treatment via the Hilton quota. Uruguay also shares (with the USA, Australia, and New Zealand) a 20,000 MT EU import quota of high-quality grain-fed beef. In its first year of implementation (2013), Uruguay allocated 6,600 MT within this so-called "481 quota." In 2015, beef exports under this quota almost doubled Hilton volume[2]. The high value of the beef exported to the EU-27 under these two quotas explains the price differentials relative to non-EU countries.

In addition to the quotas, another important factor behind Uruguayan beef price differentials is the different proportions of chilled and frozen cuts exported. The price received for chilled cuts averages 45 percent more than the price of frozen cuts. All of the beef exported to Russia was frozen, for an average FOB value of USD3,805/MT. By comparison, almost 75 percent of Uruguayan beef shipped to Switzerland (USD11,698/MT), Germany (USD11,049/MT), and the Netherlands (USD9,613/MT) was comprised of chilled cuts.

After two decades of export growth, the Uruguayan beef sector is currently experiencing some loss of competitiveness. Increasing raw material prices and labor costs in Uruguay, as well as appreciation of the local currency against the USD, have resulted in stagnation of export volumes. Furthermore, prices received for exported beef are not expected to rise in the short term, national cattle numbers have decreased, and the beef sector land base is threatened by the competition from crop production and forestry. At the end of 2015, Uruguay's beef sector is facing serious challenges. It is critical to the small nation's future prosperity that beef exports maintain and improve their competitive position and access to the global market. The country's beef sector is the historical foundation and current anchor of both the agricultural and macro economies. The beef sector is also the primary user of Uruguay's land resources; thus, sustainable exploitation of the nation's grazing lands is very much connected to sustainable economic competitiveness.

The objective of this study is to quantify the effects of public policies (i.e. taxes, subsidies, and social charges) on the various links constituting the beef sector export chain and to estimate the impact of transfers of resources between the beef industry and other sectors of the economy. The Policy Analysis Matrix (PAM) was employed to quantify the effects of public policies on the competitiveness of Uruguay's beef industry. A series of PAM coefficients were calculated to assess the competitiveness of the beef export chain in 2010 and 2013 with comparison between the two years to make policy recommendations.

2. Materials and methods

2.1 The Policy Analysis Matrix

The PAM is an instrument designed to assess the competitiveness of industrial supply chains. Originally developed in 1981 as an instrument for the analysis of changes in Portugal's agricultural policies, it has been used in numerous studies, primarily for evaluating agricultural sector investment projects, in economic efficiency studies, and for the analysis of economic policy in the context of international trade (Vieira *et al.*, 2001).

In recent years, the PAM has been adapted and widely used in Brazil by the Empresa Brasileira de Pesquisa Agropecuaria to analyze the competitiveness of several supply

chains (Lopes *et al.*, 2012). For instance, Vieira *et al.* (2001) compared PAM results for 11 Brazilian food and agricultural products: cotton, rice, cocoa, coffee, beans, milk, cassava, corn, soybeans, industrial tomato, and wheat. The information generated allowed Brazil to redirect agricultural research toward relieving technical bottlenecks in those crops or industries, in accordance with agribusiness criteria.

Previously, in Costa Rica, Jimenez and Quiros (1999) and Charpantier and Mora (1999) applied the PAM in the potato and onion chains, respectively. More recently, Reig *et al.* (2008) combined the implementation of the PAM with techniques of data envelopment analysis for modeling the profitability of Spanish agriculture. In Uruguay, Rava *et al.* (2011) used the PAM to assess private and social benefits in the Uruguayan apple export chain.

Monke and Pearson (1989) presented the theoretical concepts underlying PAM implementation, while Vieira *et al.* (2001) contributed to further development and application of PAM techniques. These two resources provide insight into the methodological adjustments made in the framework of this study of Uruguay's beef chain. In general, the PAM is the product of two identities: the first defines profits as the difference between revenues and costs; and the second reveals the effects of divergences that result from public policies that generate distortions and, if any, market failures.

The divergences can be calculated as the difference between observed patterns and those that would exist if the factors causing the divergences were removed. From that assessment, the amount of the money transfers caused by the entire set of policies affecting the system can be measured, along with the degree of economic efficiency of the system.

For the purposes of this study, the term "private" refers to the revenues and costs reflecting prices actually received or paid by producers, traders, or processors that operate in the supply chain. These prices do not necessarily equal market prices, as they can be affected by taxes or subsidies. The private prices are implicit prices. They incorporate the costs and underlying economic values plus the effects of all the policies and possible market failures on transfers within the system. The results of the calculations of private profits illustrate the true competitiveness of the sector under study, for a given level of technology, product price, input costs, and current transfers caused by public policies. The normal cost of capital, defined as the minimum after-tax return that the owners of the capital require to maintain the investment in the system, is included in the domestic costs.

In this study, the term "social" refers, in the case of income, to the prices that the agents would receive if there were no deductions due to taxes or additional income from subsidies or market failures that change the price received. In the case of costs, it refers to those actually incurred by agents, if they pay prices and wages not affected by taxes, subsidies, social security charges, or any other causes of divergence (including market failures). In this context, the PAM approach attempts to measure the effects of the policies that generate distortions, as well as market failures that could interfere with an efficient outcome. The social profit represents what private agents would receive without redistribution policies and in the absence of market imperfections or corrective policies.

Policies that generate distortions are often used because decision makers are willing to accept inefficiencies to achieve objectives such as redistribution of income, food security for the local population, or promote the development of an industry that is in its infant stage. A central part of the policy analysis is weighing the balance between the goals of efficiency and market failures, distortive policies, and redistribution. In the absence of failures affecting the product market, all the differences between private and social prices of outputs and tradable inputs (TI) are due to the effects of distortive policies.

Alternatively, policies specific to individual products usually include taxes or subsidies as well as restrictions on trade. The outcome received by producers can be increased through subsidies, tariffs, import quotas for competitive products (that increase domestic prices), or price support systems. Targeted policies promoting or discouraging the use of

certain inputs also affect private returns. Exchange rate policies can also impact product prices. The PAM is expressed in monetary units typically using the corresponding domestic currency, but international prices are quoted in foreign currency. Therefore, an exchange rate for foreign currency is needed to convert world prices to domestic equivalent prices. The social price of domestic factors (DF) is given by the underlying supply and demand conditions in the domestic factor market. Consequently, factor prices are influenced by the set of prevailing macroeconomic policies and by the pricing policies of the commodities.

The government can also apply taxation or subsidy policies on one or more factors (capital, labor, or land) that create differences between private and social costs, resulting in a grant to or a tax on the entire system. The net transfer derived from the different policies is the algebraic sum of all the divergences and can also be calculated as the difference between private and social profits. If market failures are irrelevant or non-existent, the divergences will basically measure the effects of policies that might generate distortions. Efficient systems get additional profits without any help from a distortive policy. Subsidy policies may increase the final level of private profits. A policy of subsidies is necessary to the survival of inefficient systems, but the subsequent allocation of resources for this purpose must be justified in terms of non-efficiency objectives.

Differentials derived from the cost of capital measured in terms of both private and social prices are included within the domestic or non-tradable costs, and are obtained using different interest rates. For the computation of social opportunity cost, this study used the Libor as the low-risk interest rate. A local rate was used for the computation of the private costs. More specifically, this study used an average interest rate in USD for large- and medium-sized firms, which includes the so-called "country risk" as part of the cost. Lending rates were used in all cases.

2.2 Definition of the productive system and its marketing pathway

The scope of Uruguay's beef production and export chain was defined as consisting of four basic links. The beef system involves a production and marketing corridor that starts on the ranches where cattle are born and raised, and ends at the Port of Montevideo where beef products are exported overseas. The first link corresponds to the primary sector represented by a "farm firm" engaged in agricultural activities (crop and livestock production) in a proportion corresponding to the national average.

This farm firm, defined as the first link of the beef supply chain, is neither a representative nor a predominant type of firm; it represents the technological conditions of production in the primary sector as a whole, taken down to the farm scale for the purpose of the calculations. The technical and cost coefficients at the national level are annually recorded by statisticians within the Ministry of Agriculture (DIEA-MGAP). Other than dairy farms, 14 percent of the firms that raise beef cattle also produce crops; the remaining 86 percent are purely beef cattle producers (DIEA-MGAP, 2013). The second link of the supply chain encompasses the transportation of the live animals from the farm level to the industrial plant facilities (i.e. slaughter, manufacturing, and packing) that are the third link of the chain. The fourth and final supply chain link is the movement of the beef-laden freight containers to the port.

The analysis was conducted for two different calendar years, 2010 and 2013. This study was initially part of a larger project, which intended to compute the PAM for different agri-food chains in Brazil, Argentina, and Uruguay. The 2010 PAM for the beef sector was first estimated under that project. An interest in the study results from two Uruguayan farmers' associations, the Asociación Rural del Uruguay and Federación Rural, led to a second project with the specific objective of estimating the competitiveness of Uruguay's beef sector. The new study updated the PAM and allowed for comparing changes in competitiveness between 2010 and 2013.

Revenues and costs of the second through fourth supply chain links were constructed from technical coefficients representing current average technological and logistic conditions in Uruguay. All the figures are expressed in current USD. During each period, the inputs or production factors originally quoted in Uruguayan pesos were converted to USD using an average exchange rate for the reference month (October). Per unit revenues and costs were calculated for each supply chain link using the most suitable unit (i.e. hectare, live weight, carcass weight, and shipped weight). To ensure the consistency of the units, the monetary values of the consolidated PAM are expressed in USD per metric ton of shipped product (USD/MT).

Computation of the opportunity cost of capital in each of the supply chain links was conducted using appropriate interest rates. In the case of private costs, the domestic average annual rate in USD available for large- and medium-size firms, which includes country risk as part of the cost of the public sector, was used. The exception was the computation of the opportunity cost of investment in rural land which was not calculated in the usual way. Rava *et al.* (2013) suggested that private opportunity cost should be estimated considering the rationality of the livestock producer, who considers rural land as a long-term risk-free investment. These authors recommended assigning a lease price for rented land and a 0 percent interest rate for the land owned by the cattle producer.

In Uruguay, 34 percent of the land used in beef cattle production is rented; the remaining 66 percent is owner operated. The private opportunity cost per hectare of land devoted to beef production was calculated using this rent/owner proportion. A unique low-risk interest rate (Libor) was used as the social opportunity cost of land and capital for the four supply chain links. Due to a lack of space, the complete calculations of private and social revenues and costs for each component of the Uruguayan beef supply chain are not included here but are available upon request.

2.3 Structure of the PAM

After the revenues and costs were estimated for each component of the chain, the PAM was constructed (Table II). From the private revenue and costs (A, B, and C) and social revenue and costs (E, F, and G) previously calculated, the PAM was completed via the computation of the respective profits and divergences. The first identity of the accounting matrix corresponds to profits. They are measured horizontally as revenues minus costs through the algebraic sum of the corresponding values of the first three columns. They appear in the last column and may have either positive or negative signs (±). Profits at private prices (D) are in the first row, while profits at social prices (H) are calculated in the second row.

Private and social revenues are presented in the first column as A and E, respectively. Both appear with a positive sign (+). The second and third columns are costs, all of which have a negative sign (–). The cost of TI calculated at social prices appears in cell B; the corresponding value measured at social prices is presented at cell F. The costs of non-TI, also named DF, include both labor and capital costs and are placed, respectively, in cells C (private) and G (social).

The second identity that defines the accounting matrix refers to differences between private and social values of revenues, costs, and profits. These differences, referred to as

Policy Analysis Matrix (values in USD/MT)	Revenues	Tradable inputs cost	Domestic factors cost	Profits
Private prices	+A	–B	–C	±D
Social prices	+E	–F	–G	±H
Divergences or transfers	±I	±J	±K	±L

Table II. Policy Analysis Matrix (PAM) design

Source: Adapted from Monke and Pearson (1989)

divergences (I, J, K, and L) give rise to transfers of resources from or toward the supply chain. The production transfers (I = A–E), as well as the transfers from both tradable (J = B–F) and not tradable (K = C–G) inputs represent the differences between private and social prices of products and inputs.

The net policy transfers (NPT) are obtained from summing the effects of all the policies considered by the PAM (i.e. effects on the products, tradable and non-TI). It represents the monetary value that public policies transfer from (negative sign) or toward the chain (positive sign), obtained through the sum of the individual effects of product and factor markets. Denoted by L in the PAM, the NPT also can be found by comparing the private and social benefits (L = D–H). By definition, the results must be identical because the PAM is a double entry array. Finally, the PAM allows for calculation of a set of six coefficients to assess competitiveness of the agri-industrial chain under study.

The private costs ratio (PCR) is a good indicator of competitiveness for an individual supply chain, as well as for comparing chains. It is the ratio between the absolute value of the cost of DF (non-tradable) and the added value, at private prices, PCR = |C|/(A–|B|). The smaller this ratio, the greater the competitiveness of the chain. If PCR = 1, the added value exactly pays for the use of DF in the activity (normal profits). If PCR < 1, the DF are receiving a pay-off that is higher than normal (pure profits). The activity can maintain and even expand the DF in its current use. On the contrary, if PCR > 1, these factors are not being paid in a consistent manner and may not be kept in the activity over the long run under the prevailing conditions. Minimizing the value of PCR means maximizing private profits in the chain.

The domestic costs ratio (DCR) coefficient allows for the evaluation of an individual industry and the comparison of supply chains or systems that produce different products. It is a measure of the comparative advantages of a chain. Its measurement and interpretation is similar to PCR, although in terms of social prices, DCR = |G|/(E–|F|). It indicates how many domestic (non-tradable) resources are used to generate an extra dollar through increasing exports or to save a dollar by reducing imports. Minimizing the value of the DCR is equivalent to maximizing private profits in the chain.

The nominal protection coefficient (NPC) is the ratio between the private and the social price, NPC = A/E, and measures the degree of protection in the chain, allowing its comparison with other chains that produce different goods. In this case, the social price is considered as equivalent to the international price. If NPC = 1, public policies do not alter the domestic price in relation to the international price. An NPC > 1 indicates positive protection, while NPC < 1 shows that the level of taxation makes the value received by private agents in the chain less than it would be without this distortion.

The effective protection coefficient (EPC) is the ratio between the value added at private prices and its analog at the social or international equivalent price, EPC = (A–|B|)/(E–|F|). The EPC considers the effects of distortive policies on products and TI, estimating the extent to which policies that affect these markets make the added value different from what would arise in the absence of these policies. Although the interpretation of EPC is similar to that of NPC, the EPC is a more complete measure of the incentives provided by public policies.

The profits coefficient (PC) is the ratio between private and social profits and is defined as PC = D/H. It gives an estimate of the existing profit gap and provides an indirect measure of net transfers. In addition, it is an extension of the EPC from the moment it takes potential transfers into account. If PC > 1, the activity is being subsidized in net terms. Or, if PC < 1, the chain is being taxed (also in net terms). However, it should be noted that its correct interpretation is limited to situations where both private and social profits have a positive sign (+). If both are negative or have opposite signs, the PC loses validity as an indicator.

The producer subsidies ratio (PSR) measures the net transfer caused by public policies, as a proportion of the social product, PSR = L/E = (D−H)/E. The PSR permits comparisons

of the extent to which public policies subsidize production systems. The lower the magnitude of the PSR, in absolute terms, the lower the level of subsidies in the supply chains. If PSR < 0, it indicates that the chain is taxed, not subsidized, in net terms.

3. Results and discussion

3.1 Consolidated PAM

The PAM was applied to Uruguay's beef export chain for 2010 and 2013 (Table III). All figures are annual and expressed in USD per metric ton of shipped beef (USD/MT). As it was explained above, all the costs have a negative sign (–). In that way, the direction of the transfers can be seen with greater clarity through the signs of the divergences. Positive values (+) involve transfers from other sectors toward the value chain under analysis, while negative values (–) involve transfers from the chain into other economic sectors. The only purpose of the sign is indicating the direction of the resource flow; it is showed only in the PAM. Only the absolute value will be used in the discussion, making reference to the direction of the transfer.

For 2010, the private revenue of the entire production chain was estimated to be USD/MT 3,829, a value that is 2.5 percent lower than the revenue possible in the absence of distortions (i.e. calculated at the social price and estimated at USD/MT 3,927). The net difference in revenues for the entire chain (USD/MT 98) had a negative sign, meaning a transfer toward the rest of the economy. The 2013 results are noticeably different. The private revenue of the entire supply chain grew 13.9 percent between 2010 and 2013. However, the 2013 estimated value (USD/MT 4,361) was 0.6 percent below the revenue computed at social prices (USD/MT 4,388). The resulting difference in the 2013 prices of the product for the entire chain (USD/MT 27) was also negative, indicating again a transfer of resources from the chain to the rest of the economy. Both the 2010 and 2013 results show a net transfer from the beef sector to other sectors of the economy.

As a consequence of the way private and social values were estimated in this study, the effects of public policies derived from direct taxes (basically income taxes), subsidies, and tax-return credits (value-added tax (VAT)) were represented on the revenue side. At this level, the divergences represent the net balance between these taxes and subsidies. The negative sign is due to the direct taxes paid by the beef supply chain. Because private income before taxes fell in 2013, income taxes paid by the entire supply chain in 2013 also decreased.

Public policies also affect the costs of TI and DF. The divergence observed in the TI coefficient reflects the proportion of VAT paid on input purchases that cannot be "discounted" from the private costs. In both cases, the sign was negative once more. The transfer of resources goes from the chain to the rest of the economy. The magnitudes were calculated to be USD/MT 104 in 2010 and USD/MT 130 in 2013. In 2010, the estimated private cost of TI was USD/MT 1,304 with a negative sign for the whole chain, while the social cost was USD/MT 1,200; the corresponding values for 2013 were USD/MT 1,458 and USD/MT 1,328. All the transfers moved from the chain to the other sectors. The TI increment between 2010 and 2013 was 11.7 percent in the case of private costs and 10.6 percent in the case of social costs.

Table III. Policy Analysis Matrix for Uruguay beef export chain, in USD/MT (2010 and 2013)

	Year 2010				Year 2013			
PAM (USD/MT)	Revenues	TI costs	DF costs	Profits	Revenues	TI costs	DF costs	Profits
Private	3,829	−1,304	−2,231	294	4,361	−1,458	−2,768	136
Social	3,927	−1,200	−1,741	986	4,388	−1,328	−1,686	1,375
Transfers	−98	−104	−489	−692	−27	−130	−1,082	−1,239

Notes: TI, tradable inputs; DF, domestic factors or non-tradable inputs

In the case of the DF, the negative divergence involves two concepts. First, unlike the social cost, the private cost estimated at USD/MT 2,231 in 2010 and USD/MT 2,768 in 2013 reflected social security expenses related to labor. In theory, social security costs should not be considered as transfers to other sectors of the economy. However, in the case of Uruguay, both social security and the healthcare system are primarily redistribution policies founded on the concept of inter-generational solidarity and are thus transfers out of the beef sector.

In private accounting, the opportunity cost of capital was estimated using a local interest rate, with the exception of the opportunity cost of land in the primary sector. In that case, the opportunity cost was computed as the weighted average of the rental rate applied to 34 percent of the area (leased by producers), and a 0 percent opportunity cost applied to the remaining 66 percent (owned by producers). At the social level, a unique low-risk international interest rate (Libor) was used in all cases. The social cost of DF calculated using the Libor rate in the four links of the chain resulted in USD/MT 1,741 for 2010 and USD/MT 1,686 in 2013.

Associated country risk is not considered when using this method for measuring the social cost of investments in the beef industry as an expression of the minimum profit required by the society. Therefore, the divergence observed between private and social prices of DF reflects, as a cost, the revenue required by private agents in the prevailing economic conditions (under different investment alternatives) with respect to society's requirement of at least a low-risk rate.

The observed negative divergence in the DF indicates that prices paid by private agents are higher than the prices they would pay in the absence of distortions or market failures. The results show that the social profits of the entire beef export chain were USD/MT 986 in 2010 and USD/MT 1,374.90 in 2013. Private agents involved in the chain were estimated to have received a net profit of USD/MT 294.44 in 2010, a figure that represents almost 30 percent of total social profits. In 2010, the total magnitude of the divergences reached USD/MT 692 of processed beef. In 2013, the net profit captured by agents operating in the chain was only USD/MT 136, which represented just 10 percent of total social profits.

Overall, the direct transfer of resources through taxation from Uruguay's beef supply chain toward other sectors of the economy explained 29.2 percent of the divergences found in 2010. The social security charges explained 30.3 percent while inefficiencies derived from the cost of capital and country risk explained the remaining 40.5 percent of total divergences. These percentages were 12.7, 67.2, and 20.1 percent, respectively. Although the interest rates used to compute cost of capital did not vary notably between periods, the relative increase of the cost of capital was explained by increases in live cattle investments and rural land rent.

3.2 PAM expanded by sub-sector

The results of the divergences discussed in the previous section refer to the entire beef export chain, without the recognition of differences among the composing links. However, it is important to note the individual PAM positions of each link in the supply chain: first link – livestock production firm (ranch), second link – movement of live animal to the processing plant, third link – beef slaughter and processing plant, and fourth link – movement of export-ready beef to the port. All the sub-sectors or links in the supply chain contributed to the transfer of resources out of the beef industry to the rest of the economy in both years studied (Table IV).

It should be noted that the figures are expressed in monetary terms per unit or product (metric tons or MT). That is the reason why, for instance, the revenues, costs, and benefits, as well as the corresponding transfers, are normally greater in magnitude for cattlemen than for slaughter and packing plants. As explained earlier in the materials and methods chapter, the "livestock production firm" represents the prevalent technological conditions of production in the primary sector, not a particular firm or type of firm. The same thing occurs with the other three links. In that sense, the expanded PAM shows evidence that corroborates some of the claims expressed by agents during the period under study.

PAM (USD/MT)	Year 2010 Revenues	TI costs	DF costs	Profits	Year 2013 Revenues	TI costs	DF costs	Profits
Private	3,829	−1,304	−2,231	294	4,361	−1,458	−2,768	136
1st link	2,774	−937	−1,833	5	3,659	−1,109	−2,430	121
2nd link	55	−20	−6	29	68	−26	−7	35
3rd link	971	−341	−391	239	600	−316	−330	−46
4th link	28	−5,71	−1	20	34	−7	−2	25
Social	3,927	−1,200	−1,741	986	4,388	−1,328	−1,686	1,375
1st link	2,775	−833	−1,484	458	3,659	−979	−1,465	1,215
2nd link	80	−20	−4	55	98	−26	−5	67
3rd link	1,037	−341	−252	444	588	−316	−214	58
4th link	35	−6	−1	29	43	−7	−1	35
Transfers	−98	−104	−489	−692	−27	−130	−1,082	−1,239
1st link	0	−104	−349	−453	0	−130	−964	−1,095
2nd link	−25	0	−1	−26	−30	0	−2	−32
3rd link	−66	0	−139	−205	12	0	−115	−104
4th link	−7	0	0	−8	−9	0	−1	−9

Table IV.
Expanded Policy Analysis Matrix for Uruguay beef export chain, in USD/MT (2010 and 2013)

Setting aside the transportation (second and fourth link) and concentration on the other two, it is observed that year 2010 was particularly good for the manufacturing sector (fourth link) and bad for ranchers (first link). Private profits per metric ton of shipped product reached $239 in the case of manufactures, while they were virtually inexistent ($5) for beef producers ($5). Very different was the situation in 2013, when beef plants operated with negative profits (−$46) and farmers obtained good values for their cattle, multiplying profit levels ($121) with respect to 2010.

After representing 70 percent in the previous two years, the average price paid to farmers for a fat steer at slaughter accounted by 76 percent of the implicit value of that steer, given the weighted average value of the meat products obtained from it[3], according to the data published by the National Meet Institute of Uruguay, Instituto Nacional de Carnes. However, between 2011 and 2013, this percentage jumped to 80 percent, given an increase in the cost of the main raw material (cattle) in the cost structure of slaughter/packing plants.

3.3 Competitiveness of the beef export chain

The analysis and comparison of the coefficients computed from the PAM, for 2010 and 2013, offer some additional insights for assessing the competitiveness of Uruguay's beef export chain (Table V). For instance, the computed PCR value was 0.88 in 2010 and 0.95 in 2013, indicating that remuneration of the DF across the entire supply chain resulted in a modest profit that declined from 2010 to 2013. This result indicates competitiveness of the beef industry fell between 2010 and 2013. In turn, the value for the DCR that appears in the second row was 0.64 in 2010 and 0.55 in 2013. Obtaining a value less than 1 confirms

Coefficient of competitiveness	Calculation method	2010	2013
Private costs ratio (PCR)	PCR = lCl/(A−lBl)	0.88	0.95
Domestic costs ratio (DCR)	DCR = lGl/(E−lFl)	0.64	0.55
Nominal protection coefficient (NPC)	NPC = A/E	0.98	0.99
Effective protection coefficient (EPC)	EPC = (A−lBl)/(E−lFl)	0.93	0.95
Profits coefficient (PC)	PC = D/H	0.30	0.10
Producer subsidies ratio (PSR)	PSR = L/E = (D−H)/E	−0.18	−0.28

Table V.
Indicators of competitiveness for the Uruguayan beef export chain

the competitive opportunities manifested in this economic activity, due to its comparative advantages under prevailing production and market conditions.

The NPC exhibited a value very close to the unity in both periods (0.98 in 2010 and 0.99 in 2013) indicating that, on average and in net terms, public policies do not alter the domestic (e.g. private) price with respect to the social price (e.g. proxy for the international reference price). The results indicate that public policies have a relatively neutral effect on Uruguayan beef sector competitiveness. The NPC coefficient would decrease in magnitude if taxation policies result in values received by agents in the chain are less than market prices.

The EPC represents a more robust measure of the incentives or disincentives created by the public policy, although interpretations of EPC sign and magnitude are similar to the NPC. The EPC values obtained in this study (0.93 in 2010 and 0.95 in 2013) imply that taxation results in a slight distortion in beef export chain prevailing prices.

The estimated PC, which constitutes an indirect measure of the net transfer, was positive and clearly lower than 1 (0.3 in 2010 and 0.1 in 2013), indicating that, in net terms, the level of beef supply chain taxation increased between 2010 and 2013. In addition, because this sector has a high demand for capital investment, especially in the slaughter, manufacturing, and packing processes, it is subject to a substantial divergence in the profits resulting from the cost of country risk. Finally, the measure of the net transfer given by the PSR suggests that the Uruguayan beef export chain was subject to increased net taxation between 2010 and 2013 (−0.18 in 2010 and −0.28 in 2013).

4. Conclusions and implications

The results of this study confirm that export beef production is a very competitive economic activity in Uruguay. The competitiveness exists in spite of the tax burden, the increasing weight of social security costs, and capital costs borne by all the links in the beef export supply chain. In general terms, the Uruguayan beef industry transfers a very large amount of resources to other sectors of the economy. The amount of this transfer increased from 70 to 90 percent of the total profits generated by the entire industry from 2010 to 2013. The private agents that operate in the supply chain retain the remaining profits.

In Uruguay, 2013 was an atypical year for the beef industry. Two-thirds of the observed 2013 divergences are due to inefficiencies resulting from the cost of capital and can be attributed primarily to that year's high live cattle prices. About 20 percent of the divergences were transferred out of the beef sector through taxes, while the remaining 13 percent were extracted via social security contributions.

As was noted above, social security and public health costs might not be considered true transfers to other sectors in other countries. However, in Uruguay, social security and public health are social welfare redistribution programs funded through economy-wide contributions. A certain proportion of these expenses return back to the beef supply chain through mutual coverage services, insurance for accidents or sickness, and unemployment insurance, although these effects were not included in the current PAM.

From a strictly economic perspective, Uruguay's beef export chain has been able to compensate production factors involved in the activity, although very close to long-run equilibrium levels. By analyzing conditions for each link in the chain, it is apparent that transfers originate from several different sources in different proportions in each of the four links or sub-sectors. The PAM results indicate that direct taxes and tax-return credits from indirect taxes such as the VAT are more heavily borne by beef sector manufacturing and transport activities.

DF are the source of between 70 and 84 percent of the divergences generated along the chain; social security charges explain ~70 percent of the DF divergence at the manufacturing level because this link is the most labor intensive (i.e. per ton of beef). At the farm-firm level, social security charges accounted for more than 30 percent of the divergences found in DF costs. In the second link (transporting live cattle to slaughter), social security charges

represent 60 percent of the DF while this percentage drops to 38 percent in the fourth supply chain link (movement of container beef to the port). The second source of divergence in the DF involves the opportunity cost of capital, which represents a market distortion reflected through country risk. Eventually, this cost reflects a risk premium that private firms are required to pay to owners of financial capital for investment in Uruguay.

This situation generates a flow of monetary resources from the private sector to the financial sector. Viewed from another perspective, the social cost of the investment measured through a low-risk rate expresses the minimum return required by society. In this case, the divergence between private and social prices applied to DF reflects, in terms of costs to the supply chain, the return required by the private sector in the context of the country's prevailing economic conditions. In the primary (farm-firm) sector, ~70 percent of the generated divergences are related to inefficiencies in the cost of capital. The relative weight of the factors of production (e.g. land vs capital) is much higher per ton of processed product for the live cattle producer than for the processing plant. For the latter, only 30 percent of the divergence corresponds inefficiencies in the cost of capital.

Several conclusions can be drawn from the results presented here. There is no doubt that beef production is one of the most competitive economic activities in Uruguay. The livestock sector has been the mainstay of the national economy throughout Uruguay's history and is the foundation of the nation's export activities. With the exception of a brief interruption due to a major financial crisis at the beginning of the twenty-first century, Uruguay's beef industry has shown great dynamism in the last two decades; growth rates have been high and global market position remains strong. Uruguay's livestock production system has remained competitive in spite of high levels of transfers to other sectors of the economy and the heavy burden imposed by inefficiencies related to the cost of capital. However, the competitiveness of Uruguay's beef sector is not infinite, should not be taken for granted, and deteriorated slightly between 2010 and 2013.

Some Uruguayan beef packing plants lost money in 2013. The main reason for the poor financial performance was the high cost of raw material (e.g. fat cattle) due to surging prices in live cattle markets. With respect to the cost of capital, Uruguay's position in international capital markets has improved. Country risk, measured as the gap between international and domestic interest rates, must always be taken into account by Uruguay's productive sectors because of potential impediments to development and international market competitiveness as a result of expensive financing.

The recovery of Uruguay's investment grade in early April 2012 by Standard & Poor's and later by other important rating agencies confirmed the reduction of Uruguay's country risk relative to previous years. This is important because it reduces the cost of capital required for investments in productive activities. The greatest source of uncertainty for Uruguay's beef supply chain and the larger economy is the taxation policy. These PAM results suggest that Uruguay's export beef chain is rewarding factors of production at a level close to equilibrium, and there is no extra room for increasing taxes without the risk of harming the entire beef sector. Increasing transfers from the beef supply chain to other economic sectors would seriously compromise the competitiveness of the industry.

Acknowledgment

This work is part of the normal research activities carried out by the authors at the Instituto Nacional de Investigación Agropecuaria (INIA). The project was financed 100 percent by this institution. The authors want to acknowledge the journal's anonymous reviewers, as well as to some colleagues that kindly revised the original manuscript. Their critics and suggestions greatly improved the quality of the discussion and helped to bring interest to potential readers. Any remaining potential weakness or error is the sole responsibility of the authors.

Notes

1. Law No. 17997 – Sistema de Identificación y Registro Animal. In effect since August 2006 (www.parlamento.gub.uy/leyes/AccesoTextoLey.asp?Ley=17997&Anchor=).
2. http://tardaguila.com.uy/site/index.php/es/informes-diarios/ganaderia/item/3196-embarques-481-duplican-a-los-de-la-cuota-hilton/3196-embarques-481-duplican-a-los-de-la-cuota-hilton
3. The implicit value of slaughtered steer is an index called "novillo virtual" or virtual steer, and is published on a weekly basis by INAC since January 2007 (www.inac.gub.uy/innovaportal/v/5690/10/innova.front/serie-valor-novillo-tipo).

References

Bonsignore, S. (2011), "Agregando valor a los productos cárnicos; Marca País y Marca Empresa. ¿Cómo integrar ambos enfoques?", paper presented at Foro de Carnes – Instituto Nacional de Carnes, Mesa 5/Marca País, Montevideo, June 2, available at: www.inac.gub.uy/innovaportal/file/6067/1/mesa-5—inac.pdf (accessed May 15, 2016).

Charpantier, F. and Mora, E. (1999), "Aplicación de la metodología Matriz de Análisis de Política (MAP): El caso de la cebolla amarilla en Costa Rica", paper presented at XI Congreso Nacional Agronómico, Conferencia 52, San José, pp. 471-481.

DIEA-MGAP (2013), *Anuario Estadístico Agropecuario 2013*, Ministerio de Ganadería, Agricultura y Pesca, Estadísticas Agropecuarias, Montevideo.

FAOSTAT (2013), "Food and agriculture organizaion of the United Nations. FAOSTAT – FAO's corporate database", available at: http://faostat.fao.org/ (accessed October 1, 2013).

INAC (2007), *30 años de información: 1977-2006*, Dirección de Información y Análisis Económico. Instituto Nacional de Carnes, Montevideo.

INAC (2015), "Instituto Nacional de Carnes: Información de Mercado", available at: www.inac.gub.uy/innovaportal/v/10424/10/innova.front/informacion-de-mercado:-pagina-principal (accessed September 1, 2015).

INAC (2016), "Instituto Nacional de Carnes: Información de Mercado", available at: www.inac.gub.uy/innovaportal/v/10424/10/innova.front/certificacion:-pagina-principal (accessed March 1, 2016).

Jiménez, A. and Quirós, Y. (1999), "Aplicación de la metodología Matriz de análisis de política (MAP): El caso de la papa en Costa Rica", paper presented at XI Congreso Nacional Agronómico, Conferencia 53, San José, pp. 483-493.

Lopes, M.R., de Oliveira, A.J., Torres, D.A.P., Talamini, D.J.D., Martins, F.M., de Lima Filho, J.R. and Belarmino, L.C. (2012), *Matriz de Análise de Política: Metodologia e Análise*, EMBRAPA, Brasilia.

MGAP (2001), *Legislación Sanitaria Animal*, Ministerio de Ganadería, Agricultura y Pesca. República Oriental del Uruguay. Dirección General de Servicios Ganaderos, available at: www.mgap.gub.uy/portal/page.aspx?2,dgsg,dgsg-legislacion-sanitaria,O,es,0 (accessed November 10, 2014).

MGAP (2014), *Estatus Sanitario Animal del Uruguay*, Ministerio de Ganadería, Agricultura y Pesca. Institucional, available at: www.mgap.gub.uy/portal/page.aspx?2,MGAP,mgap-estatus-sanitario-animal-del-uruguay,O,es,0 (accessed November 10, 2014).

Monke, E.A. and Pearson, S.R. (1989), *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca, NY.

OIE (2014), *List of Food and Mouth Disease (FMD) Free Member Countries*, World Organization for Animal Health, available at: www.oie.int/en/animal-health-in-the-world/official-disease-status/fmd/list-of-fmd-free-members/ (accessed November 4, 2014).

Rava, C., Lanfranco, B. and Ferraro, B. (2011), "Beneficios privados y beneficios sociales en la cadena de la manzana para exportación en el Uruguay", INIA Serie Técnica 192, Montevideo, 33pp.

Rava, C., Lanfranco, B. and Ferraro, B. (2013), "Costo de oportunidad de la tierra en la competitividad de la ganadería bovina de exportación en Uruguay", *Economía Agraria*, Vol. 17 No. 1, pp. 9-21.

Reig, E., Picazo, A.J. and Estruch, V. (2008), "The Policy Analysis Matrix with profit-efficient data: evaluating profitability in rice cultivation", *Spanish Journal of Agricultural Research*, Vol. 6 No. 3, pp. 309-319.

Reyes, W., Bruschera, O.H. and Melogno, T. (1974), *La Banda Oriental: Pradera-Frontera-puerto*, 3rd ed., Ediciones de la Banda Oriental, Montevideo.

URUNET (2015), "Descartes Datamyne LaTam – Estadísticas de Comercio Exterior", available at: www.urunet.com.uy/ (accessed September 1, 2015).

USDA (2015a), "Production and trade of all meats to expand in 2016", Livestock and Poultry: World Markets and Trade, United States Department of Agriculture, Foreign Agricultural Service. Office of Global Analysis, available at: apps.fas.usda.gov/psdonline/ circulars/ livestock-poultry. pdf (accessed December 1, 2015).

USDA (2015b), "United States department of agriculture", Foreign Agricultural Service, Global Agricultural Trade System Online, available at: http://apps.fas.usda.gov/gats/default.aspx (accessed December 1, 2015).

Vieira, R.C.M., Teixeira Filho, A.R., de Oliveira, A.J. and Lopes, M.R. (2001), *Cadeias Produtivas no Brasil. Análise da Competitividade*, Fundação Getulio Vargas, Embrapa Comunicação para Transferência de Tecnologia, Brasilia.

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